audition, deafness being much more frequent in such cases than where the air is pure and wholesome; and hence the greater prevalence of dullness of hearing amongst the poorer classes, from their residing in crowded lanes and close alleys. Here we have two effects produced from one cause, together detrimental to hearing.

The difference which we have mentioned, of the conducting power in these bodies, has had reference only to kind; but quality or condition has also its influence: thus, atmospheric air acquires with density an increase of conducting power, and has it also augmented by heat, although that produces the opposite condition. Bells are heard farther on plains than on hills, and still farther in valleys than on plains, because of the greater density of the air: if we hang a bell in an air-pump, and exhaust the receiver, and cause the clapper to strike against the bell, the sound will become fainter and fainter as the air is rarefied, and at length cease altogether when a perfect vacuum is produced. Captain Parry says that, during the intense cold experienced in Winter Harbour, he often heard distinctly people conversing, in a common tone of voice, at the distance of a mile; and instances his hearing a man singing to himself while walking along the beach at even a greater distance. Dr. Jameson says he heard, in calm weather, every word of a sermon at the distance of two miles! The air was no doubt considerably compressed in this case. Dr. Junot communicated to the Academy of Sciences the following interesting results of experiments made by him to ascertain the effect of attenuated and compressed air on the human body:—

When the pressure of the air was *diminished one-fourth*, the person placed in the receiver experienced a momentary distension of the membrane of the tympanum; inconvenience of respiration, the inspirations being short and frequent; pulse was full, compressible and frequent; superficial vessels turgid; eyelids and lips distended with superabundant fluid, hæmorrhage and syncope being sometimes induced: the skin was inconveniently hot, its functions being increased in activity; the salinary and renal glands secreted their fluids less abundantly.

When the pressure was *increased one-half*, the membrane of the tympanum suffered inconvenient pressure, which ceased as gradually as the equilibrium was restored; but respiration was carried on with greater facility, the capacity of the lungs seeming to increase, and the inspirations being deeper and less frequent. The interior of the thorax acquired an agreeable warmth, and the whole economy seemed to receive additional strength and vitality. The increased density of the air seemed also to modify the circulation in a remarkable manner; the pulse was more frequent, full, and difficult of reduction; the superficial venous vessels were reduced, and were sometimes completely effaced, so that the blood, in its return towards the heart, appeared to follow the direction of the deeper veins: the blood would thus be determined in larger quantity to the arterial system, and especially to the brain, rendering the imagination active, and giving to the thoughts the accompaniment of a peculiar charm, such as to affect some persons with symptoms of intoxication: the power of the muscular system was increased, while the weight of the body appeared at the same time to be diminished.

We have met with a pleasant anecdote of a trick played off at the expense of a conclave of philosophers, who after dinner were plied so bountifully with fresh air, perfumed with orange and lavender, that their host had difficulty in supplying the extra demand for wine, so exhilarating and sharpening were the effects of the pure air, supplied, as it probably was, under pressure.

In these circumstances, we see additional evidence of the important relation which good ventilation bears to practical acoustics. It has been shown that the conducting power of air is increased with compression: with rarefaction, on the other hand, it is diminished; as was observed by Saussure upon the summit of Mont Blanc, where the firing of a pistol produced no greater report than a child's toy-gun makes in a room. This fact, and the effects previously related, suggest a comparison of the respective merits of those modes of ventilation wherein the impure air is *drawn off*, and the pure thereby caused to follow as it were by suction and to make good the partial vacuum or rarefaction, with those wherein the pure is *forced in*, causing the impure to vacate by sheer pressure; and the result of the inquiry is necessarily in favour of the latter, seeing that compression of the air is at once favourable to its vivifying and its conducting powers.

Sounds are conveyed to a much greater distance during the night than during the day; which is considered to be mainly attributable to the air during the latter being traversed in all directions and disturbed by minute and singly undistinguishable sounds or pulsations—perhaps the last expiring vibrations of many sounds, together constituting that peculiar hum which distinguishes the "city closely pent" from peaceful rural scenes; and the absence of which gives to the night its death-like stillness.

The strong tendency of sound to ascend is proved at Table Mountain, at the ridge of which, 3,600 feet high, and rising perpendicularly about a mile from Cape Town, every noise made below, even the word of command on parade, is distinctly audible. Humboldt remarks that the barking of a dog has been heard when the listener was about three miles above, in a balloon. This phenomenon is probably solely owing to the upward direction of the heated atmosphere, and will hold good sensibly in as well as out of doors, where the currents may be active.

We have thus far spoken only of air as a conductor; and this for the reason that it is the principal agent for that purpose with which we are surrounded; but amongst fluids we have one much more active,—namely, WATER: on this body it does not appear that direct experiments have been made to ascertain the measure of its transmissive power; but which would doubtless vary with its density: in the absence, however, of such deductions, it has been inferred analogically, or by calculations founded on the relative elasticity of air and water, that the velocity of sound in the latter is 4,900 feet per second. Dr. Franklin thought he heard, in water, the sound of two stones struck together, immersed in the same, at the distance of a mile. It is asserted that the human voice has been heard over water, without the aid of art, the distance of from ten to twelve miles,—namely, from New to Old Gibraltar; and the cannonading in a fight between the English and French, in 1672, was heard at the distance of 200 miles over water.

But it is amongst solids that we find the best conductors of sound; and iron and glass appear to possess that power in the greatest degree; the rate of transmission in the former, according to Biot, being 10½ times that in air, or 11,865 feet per second, while in the latter it is stated to be as much as 17,500 feet. Dr. Chladni estimated the velocity in certain materials to be as follows:—

Air being represented by	1
Silver was	7½
Copper	9
Iron	17
and wood of different kinds from	11 to 17

His estimate would raise the velocity in iron to 19,210 feet per second, but it is probably excessive.

In respect to wood, it is well known that the ear applied to one end of a long beam will hear distinctly the stroke of a pin's head at the other extremity; but be it observed, that the same will scarcely be heard across the breadth of the piece, so much has the fibre to do in the matter, and the more so as it is straightened and more free from the interruptions of knots. When one extremity of a stick is held between the teeth, and the other is placed in contact with a table, the scratch of a pin on the table may be heard, though both ears be stopped. So sonorous, in fact, is wood, that it is chosen as the fittest substance for most musical instruments: it is also the material of which the stethoscope is made, with which we listen to the action of the lungs and heart. The difference between those substances which consist of fibres and such as are composed of grains, in regard to power of conduction, is fully exemplified in this material, and is worthy of remark: cases will occur for which sometimes the fibres and at others the more homogeneous material will be best adapted.

Stone is reckoned a good conductor of sound, but it renders the tone rough and disagreeable: a well-made brick wall has been known to convey a whisper nearly 200 feet. (For its conducting power, see THE BUILDER, vol. 3, p. 443). Of the earth as a conductor, we may judge by the fact that the North-American Indians apply their ears close to the ground to ascertain the approach of their enemies, when the distance is too great for the sound to reach them through the air: in like manner an army, bivouacking in the open air, has been apprised of the advance of a hostile force, the trampling of men and horses being much sooner heard through this medium. Generally, all solid bodies, the mass of whose structure is susceptible of vibratory motion from sounds impinging on their external atoms, possess the capability of transmission.

From what has been adduced respecting the force of sound, and especially as regards the human voice (and to which may here be added that Wesley once preached, and was well heard, in a natural amphitheatre of hills, to a congregation of 20,000, who must have occupied a space of nearly an acre and a half), it would appear that scarcely any apartment can be too large for its powers; that where it fails in such as are of ordinary size, the cause must be in construction; and that where this approaches perfection, little provision will be necessary for enhancing the effect of these powers. And, as regards the powers of substances as vehicles, the inference is, that in buildings, these act mainly as defecting agents, and their defects have to be guarded against.

We have dwelt thus much on the powers of various media to convey sound, because of the great regard which is given to *form* over *material*, in all questions on practical acoustics. The attractive fact of two persons placed considerably apart, but in the two foci of an ellipse, hearing each other comfortably (almost confidentially), seems to be the turning point at which all go off in the sole pursuit of form in designing an apartment; as if it were exclusively necessary and sufficient, in our churches and halls, that intermediate points should be provided for forwarding the voice of the speaker. We are convinced that what is mainly wanting is the prevention of defecting agents, and the obtaining for the voice or other organ of sound the fullest undisturbed predominance for the time being. The thousand coughs, and sniffs, and hems, notes of admiration and interrogation, the shuffling and the creaking, even of good listeners, the hum of street sounds through single, and often rattling, casements, with a remainder, too numerous to mention, though singly inconsiderable, yet aggregately aggravating, being generally equal to at least one more voice (or other organ as aforesaid), will suffice of themselves to render indistinct the best enunciation; but when to these are superadded more permanent destroying agents, the property of some of which is to absorb or give passage to, and of others to furnish echoes of, a voice which we shall suppose is no more than sufficient in volume to fill the space without any to spare, or in its articulation is just distinct enough to be understood when carefully followed,—it is easy to perceive the almost impossibility of ensuring that any building, for oral (and aural) purposes, and of whatever form, shall be well adapted for hearing in.

Were form the sole consideration, there would be a limit to the positions in which, in large apartments, the speaker and his auditors could be relatively placed, and the semi-ellipse, parabola, or some similar form of plan, with the rostrum in its focus, must prevail: with such an arrangement, the speaker harangues his audience the most advantageously, since, besides the circumstance of favourable construction, his auditors are exempt from the trouble of adapting themselves to the reception of sound from a new and perhaps unexpected quarter; but where many speakers have to succeed each other, it has objections which must be sufficiently obvious; and it becomes equally evident that where the form of plan referred to is not adopted, but one in which there is no limitation of the point from which the voice may issue, no such geometrical method can be pursued, or at least to any great extent carried out; but the acoustical arrangements must in the main be of another